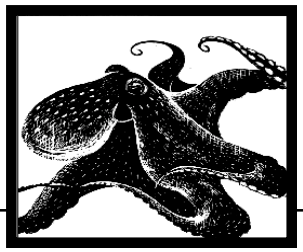


Research Program

The Role of Research in Addressing Ecosystem Management Issues

Basic to the function of the Channel Islands National Marine Sanctuary (CINMS) is the development and application of a rigorous, objective research program for evaluating ecosystem health and implementing effective resource management strategies to fulfill both site objectives and the mission of the National Marine Sanctuary Program. CINMS' research program strives to collect statistically sufficient data on marine resources, ecosystems, and the human community to understand: 1) how biological communities function naturally, 2) how different biological components interact and are integral to the health of the ecosystem, 3) the cause and effect relationship of human activities on the natural system, and 4) how ecosystems change over time due to natural perturbations and anthropogenic factors.

CINMS is working to build a research plan that compliments the national research program priorities by focusing it's data collection efforts in the following three areas: 1) ecosystem assessment, 2) ecosystem monitoring, and 3) ecosystem processes. Development of research projects in these three areas will help CINMS build a strong foundation of sound science on which to base management decisions. This foundation will also allow CINMS to identify gaps in knowledge about the resources, to better identify future research needs, and address increasingly complex resource management issues. CINMS participates in research projects on the following basis: 1) intramural *research projects, funded by the Marine Sanctuary Division and conducted by CINMS staff, 2)* extramural *research projects, funded by grants and conducted by outside agencies and institutions, and 3)* directed *research projects, carried out at CINMS with funding and execution by outside agencies and institutions, with guidance and support from CINMS and the Marine Sanctuary Division.*

In addition to data collection efforts, CINMS is assuming a much needed and emerging leadership role in the community by taking a systems approach to identifying research needs, collaborating and coordinating research efforts between agencies and institutions, analyzing and disseminating data, and identifying practical management applications for existing data.

OFFSHORE WATER QUALITY MONITORING PROGRAMS

Issue: Water Quality

objectives: State, County, City and NGO data collection efforts in the Southern California Bight are heavily focused on coastal waters and streams. As an offshore site, CINMS is directing it's efforts on the Santa Barbara Channel and the waters surrounding the Channel Islands to better evaluate and understand: 1) localized and large scale spatial and temporal impacts from oceanographic and climatic changes such as El Nino and La Nina events, and 2) impacts from increases in human population in the coastal zone and subsequent pressure(s) on offshore marine resources. The four water quality monitoring programs that CINMS supports address a full range of water quality issues and impacts on the offshore resources of CINMS.

action plan: CINMS currently supports and participates in numerous water quality data collection efforts, and will continue to do so on a long-term basis. In addition to collecting data, CINMS will support the processing, analyzing and integration of additional relevant data for a better understanding of the dynamics of healthy, functioning ecosystems and the biological implications of impacts on the resources. Statistically sufficient and relevant data sets will provide CINMS with the ability to develop

predictive models to better determine changes over time, allowing resource managers to be proactive instead of reactive to water quality impacts.

program descriptions: the following water quality data collection efforts are all *directed* research projects, conducted with staff and/or vessel support from CINMS, and with funding and support from other agencies and/or institutions.

PLUMES AND BLOOMS
is a study of the impacts of storm runoff on the marine environment of the Santa Barbara Channel. Part of an on-going study, CINMS and UCSB scientists, using the Sanctuaries' *Seawolf* and *R/V Ballena*, are attempting to ground-truth SeaWiFS (Sea-Viewing Wide-Field-of-Vision Sensor) satellite acquired ocean-color data. One of the primary goals is to develop, apply and validate state-of-the-art tools for quantifying concentrations of suspended sediments, phytoplankton pigments and dissolved organic materials using satellite ocean color imagery. *Plumes and Blooms* research provides valuable ocean color data for CINMS to better understand and manage freshwater and terrestrial inputs in the marine environment.
partners: UC Santa Barbara, NOAA, NASA, ONR, CSC, COP

BIGHT '98
was a regional monitoring survey of the Southern California Bight, coordinated by the Southern California Coastal Water Research Project (SCWWRP) to assess cumulative impacts of contaminant inputs and evaluate relative risks among different types of stresses. In 1998, more than fifty five agencies coordinated efforts to sample 416 sites between the Mexican border and Point Conception. Multiple indicators were measured at each site to relate contaminate exposure, biological response, and habitat condition. Thirty-one trawl samples and thirty-seven benthic samples were collected off the *R/V Ballena* at randomly selected sites in the Sanctuary. Useful comparative data about the relative health of the Sanctuary to the mainland coastal region was collected. The research may assist the Sanctuary and other resource managers in answering questions about: 1) which areas do or do not meet water quality standards, 2) geographic distribution of impacts, 3) comparison of relative risk from point and non-point discharges, 4) the relationship between contaminant exposure and biological response, and 5) understanding historical trends at selected sites. Data from the 1998 cruise is currently being processed and analyzed. Next cruise scheduled for 2002.
partners: 50 agencies and institutions

CODAR
is a tool used to examine the feasibility of using high frequency Coastal Ocean Dynamics Applications Radar (CODAR) systems to observe the patterns of evolution of surface currents in the waters off the south-central coast of California. This tool can provide maps of evolving surface currents in the offshore waters. The ability to observe surface currents in real-time over horizontal length scales of tens of kilometers could improve CINMS' and other agencies abilities to respond to oil spills. In addition, observation of evolving surface current fields will provide new insights into the dynamics of the very top of the water column including advection and dispersion of larval stages of a wide variety of fish and invertebrates. CINMS is currently coordinating efforts with Channel Islands National Park, on behalf of UCSB researchers, to place CODAR systems on the Channel Islands to better track evolving surface currents in Sanctuary waters. CINMS will provide support in maintaining the CODAR systems and share data collected from this project. These data will not only help the Sanctuary in developing trajectory models for emergency response, but also help in the understanding of the life history of the living marine resources of the Channel Islands.
partners: UC Santa Barbara, NASA, CINP

PISCO
Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) is a consortium of four universities (Oregon State, UC Santa Cruz, Stanford University, and UC Santa Barbara) who have joined together to investigate the physical and biological processes of the nearshore region along 1200 km of the Oregon and California coasts. Initially, four sites of particular ecological significance will be intensely studied: Pt. Conception and the Channel Islands, Monterey Bay, and the central Oregon coast. CINMS will provide staff and vessel support for intensive sampling of larvae, recruits, and post-settlement individuals in both subtidal and intertidal communities, combined with simultaneous monitoring of nearshore waters using a mooring array, benthically mounted Acoustic Doppler Current Profiles (ADCPs), coastal radar units, and remote sensing. PISCO has made a commitment to education, outreach, and to form policy links needed for analysis and implementation of programs in marine conservation.
partners: Packard Foundation, Oregon State, UC Santa Cruz, Stanford University and UC Santa Barbara.

(for all 4 water quality projects)
products: data collected from the four water quality monitoring projects are essential to the development of predictive modeling capabilities used to assist CINMS in the Geographic Information System (GIS) mapping of potential impacts and changes in water quality over time. These models may be used by the

Sanctuary and other resource managers to assist in decision making, by agencies for emergency response, and scientists to link to other research.

time lines: 1) data collection for all four projects will be on-going, 2) encyclopedia of historical data and trends in place by year ten, 3) ability to develop predictive models as a decision making tool for CINMS resource managers to be complete by year ten.

performance indicators: 1) data collection - CINMS will collect, acquire and integrate enough statistically sufficient data to develop predictive models for emergency response and water quality protection by year five, 2) program design - CINMS will design a program for data integration, develop a framework for filtering out relevant and useful data and have in place predictive modeling capabilities by year ten.

SANCTUARY AERIAL MONITORING & SPATIAL ANALYSIS PROGRAM

Issues: Vessel Traffic, Visitor Use, Emergency Response, Resource Protection

objectives: the Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP) allows real-time collection and near real-time viewing of data vital to Sanctuary management and resource protection. Using the Sanctuary's amphibious fixed wing Lake Renegade Sea Wolf as a platform, SAMSAP is utilized for three principle research efforts: 1) vessel traffic monitoring (visitor use), 2) marine mammal sightings, and 3) kelp canopy monitoring. Increased frequency of mission flights to expand the current database to a statistically significant size is needed to better analyze historical data and create predictive models for resource management.

action plan: to collect statistically significant data on vessel traffic and marine mammal sightings, the Sea Wolf needs to fly on a weekly basis (including weekends). Kelp canopy monitoring data is collected on a seasonal basis requiring monthly overflights.

program description: a basic survey mission (vessel or marine mammal survey) consists of a data recorder entering information specific to a sighting into the survey program. Coordinates are automatically recorded. After a transect is complete, the file is converted to GIS and the data are classified and displayed over a base map. Other data layers, such as sea surface temperature may be added to allow queries across data types. Data are comparatively analyzed with other sampled physical and anthropogenic phenomena to observe trends and locations. Animations of historic data are created to aid in the visualization of visitor use and marine mammal migration patterns over variable time frames. Kelp canopy data sets include forest locations, perimeter coordinates, and density of cover. The data are used to assess the health and distribution of macrosysis pyrifera (giant kelp) in Sanctuary waters. In addition to the data collection efforts, SAMSAP is being prototyped as a response tool for resource emergencies such as oil spills. Data collected on spill perimeter changes, spill trajectories, oil types, and endangered animals can be realtime downloaded directly from the aircraft to a portable GIS at Unified Field Command centers to aid in both immediate response decisions and long term impact analysis.
partners: NOAA-AOC, NESDIS

products: data collected from the vessel traffic surveys will help assist the Sanctuary in understanding levels and types of visitor use, both recreational and commercial, that take place in Sanctuary waters. These data are essential for understanding visitor impacts on marine resources to make sound management decisions. Marine mammal data will provide valuable information on migration patterns to better understand seasonal use of Sanctuary waters by cetaceans and pinnipeds. Kelp canopy monitoring data will help in the effort to assess the impacts of local and global climatic and oceanographic changes on the health and distribution of kelp forests. These data will be made available to scientists, decision makers and the public for predictive modeling.

time line: 1) data collected from all four SAMSAP monitoring projects will be on-going, 2) encyclopedia of historical data and trends in place by year ten, and 3) development of intuitive prediction model available for public use by year ten.

performance indicator: general public access via the web on an on-going basis, and use of SAMSAP data for predictive modeling in use by year ten.

SITE CHARACTERIZATION

Issues: Resource Protection

objective: to develop an inventory and description of habitats, biodiversity, ecological processes, links with abiotic processes (e.g. climate and physical oceanography), and interactions with natural and human disturbance. A baseline inventory is necessary to build a historical database on Sanctuary resources to determine: 1) change over time, 2) effectiveness of CINMS' resource protection efforts, 3) the effects of human activities on natural systems, and 4) profile socioeconomic information on the scenic and existence value of resource conservation.

action plan: the Sanctuary's role is to actively coordinate and encourage research efforts of other agencies and institutions, provide platform and personnel support for research conducted by CINMS and other agencies, and synthesize existing information to better identify data gaps and information needs. In addition, CINMS will create a structure for data integration and develop a methodology for intuitive data query to be used by resource managers through web base access.

program descriptions: the following site characterization projects are all *directed* research projects, conducted with staff and/or vessel support from CINMS, and with funding and support from other agencies or institutions.

MAPPING THE SEA FLOOR
since 1997, CINMS and the US Geological Survey have conducted an on-going survey to characterize benthic habitats in and around the waters of CINMS. With the *R/V Ballena* as a launch platform, side scan sonar has been used to ground truth satellite imagery of bottom types and bring a to a finer resolution Sanctuary bathymetric maps. With 30% of the mapping complete in Sanctuary waters, it will take an estimated 10 more years to map the entire Sanctuary.
partners: US Geological Survey

MARINE RESERVES STUDY
four marine ecological reserves (Big Sycamore Canyon, Vandenberg, Anacapa and San Miguel) were established in California in 1994. CINMS is providing staff and vessel support to produce bathymetric maps, overlay habitat and sediment characteristics, determine prevailing current patterns that drive larval dispersal and juvenile recruitment and compile a list of resident fish fauna. These data will provide resource managers with important baseline information on fine scale distribution of planktonic fish eggs. The ultimate goal of this on-going study is to measure the production of planktonic shorefish eggs from these four "no take" zones, compare to areas where extractive activities take place, and track historical trends to determine effectiveness of resource management.
partners: NMFS, USGS

BREEDING COLONY AND ROOST SURVEYS
breeding colony surveys (Brandt's and Double-crested cormorants) and roost surveys (cormorants, Brown Pelicans and gulls) throughout the entire Southern California Bight (Cambria to Mexican border) will be photographed from an aircraft and later counted. Data will contribute to baseline inventory on seabird populations and distribution in Sanctuary waters.
partners: Humbolt State University, USGS. US Navy, US Fish and Wildlife Service, American Trader Trustee Council, CDFG, Channel Islands National Park, and Minerals Management Service.

(for all 3 site characterization projects)
products: CINMS will build: 1) a complex spatial data base with full relational data, and 2) a methodology for intuitive data query for resource managers with easy web base access.

time line: 1) data collection for all five projects will be on-going, 2) data integration tool, intuitive methodology and web base access will be complete by year ten.

performance indicator: scientists and resource managers accessing and making use of complex spatial data base by year ten.

ECOSYSTEM MONITORING PROGRAMS

Issue: Resource Protection

objectives: site characterization allows CINMS to build a baseline inventory of the physical/biological make-up of the Sanctuary's living and non-living resources. A system-wide *ecosystem monitoring program* will enhance efforts to track structural, functional, biological, chemical and physical conditions of these resources over long periods of time to identify changes as a result of anthropogenic and/or natural disturbance. CINMS is currently participating in a wide variety of monitoring efforts. Monitoring efforts are focused on important management issues, both current and emerging. Based on information from these monitoring programs, actions may be taken to address any adverse impacts to more effectively conserve, enhance, and restore habitats and ecosystems.

action plan: to continue to support and coordinate monitoring efforts conducted by other research institutions in the Sanctuary. CINMS will track, acquire and synthesize data. In addition, CINMS will identify monitoring needs and gaps that address new and emerging resource management issues.

program descriptions: the following monitoring programs represent *intramural*, *extramural* and *directed* categories of research projects and funding scenarios. Some of the programs are on-going, others are meant to be immediate and timely to address new and emerging issues.

BIGHT 98
the Southern California Coastal Water Research Project (SCCWRP) directs a project to sample a variety of water quality indicators including benthic invertebrate assemblages, demersal fish assemblages, dissolved oxygen, temperature and salinity (see page 2 for more details). These data are not only important to assess water quality, but provides relevant data on fish and invertebrate assemblages in Sanctuary waters.
partners: 55 agencies

SAMSAP
the Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP) is making a valuable contribution to on-going monitoring efforts in the Sanctuary by tracking vessel traffic (recreational and commercial visitor use), marine mammal sightings, and kelp canopy monitoring. CINMS vessel and marine mammal databases have grown large enough to permit seasonal comparisons of animal and human location patterns. Environmental information has been added to the survey data to help analyze correlations and variations between surveyed attributes and physical factors relative to their locations. The aircraft's data collection software and GIS are fully integrated to produce clear maps and pictures of events in Sanctuary waters. With more flight time dedicated to SAMSAP in the next five years, a statistically significant data base will be developed to identify historical trends and prediction models. These data may point to important clues about cause and effect relations from human activity and natural seasonal events in Sanctuary waters
partners: NOAA -AOC

SEABIRD STUDIES
Xantus' Murrelet
Using the R/V Ballena as a platform, Xantus' Murrelet baseline population data are being collected around Anacapa Island. At-sea radar studies, at-sea captures, at-sea nocturnal vocalization surveys, and sea-cave nest searches are being used to obtain several measures of baseline data. These data will be used to compare future data to help measure an anticipated Xantus' Murrelet population increase after the eradication of Black Rats on Anacapa Island.

Cassin's Auklet
Using the *R/V Ballena* as a platform, radios will be attached to auklets at Prince Island and Scorpion Rock colonies. Aircraft will then be able to track the auklet's distribution at sea. The *Ballena* will then head out to sea where observations will be made on auklet prey and oceanographic foraging features.

Northern Channel Islands Seabird Colonies
The California squid fishery, as of 1999, was the largest fishery in the state in terms of revenue generated. 70%(?) of the state's squid fishery takes place in Sanctuary waters. With an influx of squid boats, and accompanying light boats (used at night to attract spawning squid to the sea surface), entering the market, there has been an unforeseen potential impact on nesting birds. CINMS is providing vessel and research support for data collection efforts to determine the degree of impacts squid light boats have on seabird reproduction and population size. Seabird colony surveys will be conducted in the coastal areas of the northern Channel Islands.
partners *(for all seabird studies)*: Humbolt State University, USGS. US Navy, US Fish and Wildlife Service, American Trader Trustee Council, CDFG, Channel Islands National Park, and Minerals Management Service.

KELP FOREST MONITORING-CINP
since 1981, 16 sites in the Channel Islands National

Marine Sanctuary and Channel Islands National Park have been monitored on a regular basis. These sixteen sites were selected to represent a range of biogeographical and physical settings of kelp forests in the CINP and CINMS. CINMS staff work with CINP carrying out sampling schemes including: quadrants, band transects, random point contacts, visual fish transects, size frequency surveys, thermographs, video surveys, photogrammetric plots and species inventory surveys. These data indicate temporal trends for 68 kelp forest taxa, at 16 sites for 12 years. Data also reveal differences in abundance of benthic organisms at different locations. This project is one of the longest on-going data collection efforts in Sanctuary waters, providing statistically significant data on one of the Sanctuary's unique and prolific habitats.
partners: CINP, CDFG

ROCKY INTERTIDAL MONITORING -
Channel Island National Park's long-term monitoring of the rocky intertidal community is accomplished by biannual sampling of permanent photoquadrants and black abalone plots. Site selections were based on the following criteria: 1) representative of different aspects of geology, currents and wave action, 2) representative of various levels of visitor use and popularity, 3) good access from the island or a protected safe landing nearby if boat access is necessary, 4) protected from large waves at low tide, 5) relatively level ease for monitoring the site, 6) representative of intertidal resources for that particular island, 7) representative coverage for the five intertidal zones to be monitored, and 8) close proximity to kelp forest monitoring sites. The purpose of the rocky intertidal monitoring program is to track seasonal and annual changes in populations of rocky intertidal organisms. On-going since 1982, the program's goals are to: 1) monitor trends in population dynamics of selected indicator organisms, 2) determine normal levels of variation, 3) discover abnormal conditions, and 4) measure the effects of management actions. Data indicates changes from natural events such as El Nino on the study species, the varied distribution of species, and the influence that habitat has on the abundance of species.
partners: CINP, UCSB, MMS

time line: SCCWRP, SAMSAP, Kelp Forest Monitoring and Intertidal Monitoring are all on-going monitoring programs. Seabird studies are short term studies, intended to address immediate resource management questions/issues.

performance indictor: data are analyzed and being used by CINMS to address resource management issues and make sound resource management decisions by year three. Data to be made available an interpreted for the public by year five.

FISHERMAN'S MONITORING PROGRAM

Issues: Resource Protection, Monitoring

place holder
(waiting for confirmation)

REMOTE SENSING

Issue: Resource Protection

objective: to integrate satellite, aerial, and sonar data into current Geographic Information System (GIS) programs to increase CINMS' ability to carry out more complex spatial analysis.

action plan: procure remote sensing software and perform in-house research and algorithm design. Partner with other NOAA divisions and outside agencies for data sharing and dissemination.

program description: CINMS will continue current research programs involving data collection on natural and anthropogenic phenomena in the Sanctuary. To enhance the resource management value of these programs, remotely sensed data will be integrated into existing and future research.
partners: NMP, NESDIS

timeline: remote sensing capabilities fully integrated into all appropriate research projects by year five.

performance indicator: the ability to create original products derived from raw imagery, georeferenced aerial photos in use for back ground layers, new methodologies to track physical and biological changes, and new products to identify and track oil spills all in place by year five.

DATA MANAGEMENT

Issue: Emergency Response, Water Quality, Vessel Traffic, & Visitor Use

objective: to develop a well designed information management and dissemination system to facilitate conservation science based management. This system is designed to be widely applicable and accessible to CINMS staff, scientists, decision makers and the public.

action plan: using CINMS' existing infrastructure capacity with outside software expertise, the Sanctuary will develop a system in which to integrate a large volume of data, process all in-coming data, synthesize and analyze the data. To maximize the utility of the data management system, the user should be able to connect across the system for individual querying of all available data sets. The system will be made available for practical application on both an intuitive and expert level.

program description: By setting up a data base on an in-house served computer, CINMS can expand the range and uses of existing data. Additionally, any user will be able to bring in a data base, upload into the Sanctuary's system, and carry out any type of data analysis or processing from statistical analysis to support for management decisions.
partners: CINMS

time line: 1) bring in outside software expertise and set up data base on in-house served computer by year one, 2) process, synthesize and analyze existing data base by year five, 3) system set up for individual querying of data in place by year five.

performance indicator: the data management system should prove to be an effective depository for data collected by institutions in the region and is utilized by CINMS, other resource managers, scientists and stakeholders by year ten.

RESEARCH INTERPRETATION

Issue: Resource Protection

objective: to communicate and interpret for the public, NOAA, the scientific community, and other resource managers about the research activities that take place in and around Sanctuary waters. A successful interpretation and outreach program will also help to establish an on-going and open dialogue between scientists, managers, and the public. Better outreach will lead to a better understanding of Sanctuary resources and their value, ultimately leading to more informed participation in resource management decision making and ocean conservation. As an offshore site, CINMS needs to reach out to the regional human community to make a connection between their activities on land and impacts on the marine environment. Teaching the public about the value of the natural ecosystem, how human activities affect it, and the connection between a healthy economy and healthy ecosystem is the role of the research interpretation program.

action plan: CINMS will work more closely with the scientific community to serve as a clearinghouse for scientific information, identify information gaps, coordinate and disseminate data and interpret research generated by the scientific community for public consumption.
program description: research interpretation efforts aimed at user groups, the scientific community and resource managers fall into two categories: 1) outreach strategies designed as interactive programs (internet hosted workshops, conferences, and meetings), and 2) the development of products and the use of media as communication tools (printed materials, web site, audio visual materials).

CINMS will establish a program to ensure public involvement in the Sanctuary by developing a series of workshops on research activities. These workshops will enhance communication between the research community, the public and Sanctuary staff.. The focus of product development is to disseminate current research and results to the public in a timely fashion CINMS will develop an annual report, for both print and web media, interpreting research activity in and around the Sanctuary during the past year. Materials shall be multilingual when appropriate and necessary.
partners: CINMS Education Department, Sanctuary Advisory Council.

time line: research interpretation will be an on-going effort. Printed materials with description of research projects and findings will be developed by the end of year one and updated on an annual basis. The research web site will be developed by the end of year one and updated on a monthly basis. The first CINMS annual

research meeting will be held by the end of year one, and on an annual basis thereafter. A bi-monthly seminar series, open to the public, on current research and resource management issues, in place by end of year one.

performance indicators: an increase in demand from the public and scientific community for information, products, and programs by year three. An increase in the level of knowledge of target audiences about the Sanctuary by year five. Increase in participation in public programs by year three. CINMS successfully facilitates an on-going and open dialogue between scientists, managers, and the public by the end of year three.

RESEARCH PERMITS

Issue: Resource Protection

objective: the research permitting program provides CINMS with the ability for oversight and tracking of research activities occurring in Sanctuary waters. Research activities should provide: 1) further understanding of the complexity of the three bioregions represented in the Sanctuary, 2) further the educational, natural, or historical value of the Sanctuary, and/or 3) provide appropriate and useful data for sound resource management decision making.. Research permitting strategies are intended to facilitate and enhance the capabilities for conducting research and monitoring activities in the Sanctuary.

action plan: research permitting will be conducted and coordinated by Sanctuary staff. Permits will be signed by the Sanctuary manager, and permit possession will be enforced by the Sanctuary staff.

program description: the research permitting process falls into three categories: 1) a permit to conduct activities otherwise prohibited within the Sanctuary, 2) Sanctuary review of other agencies' research permits for research activities in Sanctuary waters that comply with existing CINMS regulations, and 3) a voluntary research registry for research activity that requires no agency permit(s). When determining research to be conducted, the potential for damage will be evaluated against the expected benefits of the outcome or use of the data. Research that may result in resource alteration must be of the highest quality and beneficial to the Sanctuary. The permitting process will remain simple, straight forward, and will not require substantial resources from either CINMS or the applicant. The results of permitted research must be made available to the Sanctuary.

time line: permitting procedure currently in place. Voluntary research registry to be in place by end of year one.

performance indicators: CINMS is able to track and monitor all research activities occurring in Sanctuary waters by end of year three. CINMS is able to direct research activities to better support resource management needs by end of year five. CINMS incorporating 50% of all data collected in Sanctuary into data base by end of year five.

OTHER ISSUES UNDER CONSIDERATION

The above mentioned research programs address specific resource management issues. Other site specific issues will be addressed by the research program during the next five years. These issues are not limited to, but will include:

ZONAL MANAGEMENT

marine zoning is a management tool used around the world to protect sensitive marine resources from human impacts. Zonal management protects species and habitats by limiting consumptive and/or conflicting user activities, allowing resources to develop in a natural state with minimum human disturbance. As CINMS is assessing the usefulness of zonal management as a resource protection tool, the research program is looking at an array of monitoring programs to be used to evaluate the effectiveness of zonal management over time. Long term monitoring will provide important information for comparing the effects of natural processes and consumptive activities on species and habitats.

OIL AND GAS ACTIVITIES

Rigs to Reefs is a program increasingly used in the Gulf of Mexico by the oil and gas industry to offset the cost of platform removal by creating artificial habitat out of partially removed rigs. Artificial reefs generally increase the area of hard bottom, but improper placement may harm existing bottom habitat(s). The *Rigs to Reef* program is under consideration as an artificial reef tool in the northern Southern California Bight. CINMS will be surveying existing data to determine the impacts of artificial reefs on fish and invertebrate populations, and evaluate habitat modifications caused by the installation of the structures. Location of placement and size of structure are other factors that will be looked at. If

appropriate, CINMS may want to consider regulations

for artificial reef construction and evaluate habitat suitability for placement of rigs.

EXOTIC SPECIES
little is known about the damage to the marine resources of the Channel Islands from the inadvertent or intentional release of exotic species. CINMS considers exotic species as those plants or animals whose natural zoogeographic range would have not included the waters of the Eastern Pacific without passive or active introduction through anthropogenic means. The spread of exotic or invasive species such as the zebra mussel and green crabs in other parts of the country, creates much interest for CINMS, particularly with the proximity of vessel traffic lanes to the Sanctuary. Ballast water exchange from shipping traffic is one of the major areas of concern. CINMS' research department will closely track this issue, identifying potential sources, impacts and regulatory recommendations.

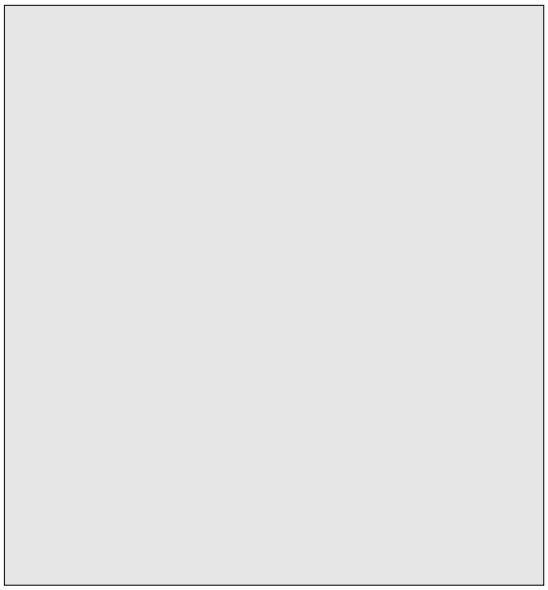
NEW AND EMERGING RESOURCE MANAGEMENT ISSUES
Growth and change in human activity, and better tracking of natural perturbations in and around the Channel Islands, has led to every changing and potentially increasing impacts on the natural resources of the Channel Islands National Marine Sanctuary. Questions about impacts from squid light boats on nesting endangered California Brown Pelicans, and the effects of the eradication of Black Rats on Anacapa Island on Xantus' Murrelets are some of the current issues CINMS' research program is tracking. These efforts require a constant and continuous tracking of the condition of the natural resources and changes in human activities in and around Sanctuary waters. This is an effort to be proactive about resource management issues, and, if possible, avert any potential impacts on the Sanctuary.

SANCTUARY RESEARCH PLATFORMS

R/V BALLENA
is equipped to support a variety of oceanographic and biological studies. The *Ballena* has a fiberglass hull, is 56 feet in length, 17 feet in breadth, and draws 5.5 of water. In addition, the boat carries a 13-foot Avon inflatable with a 15-hp Evinrude outboard for landing, shallow water work, photography and other nearshore needs. The boat is well suited to serve as a research dive platform. The. *Ballena* carries state of the art bridge electronics and oceanographic equipment. The. *Ballena* can spend up to 4 days at sea, with a maximum speed of 11.5 knots. She can carry up to 18 day passengers and 7 overnight passengers.

R/V XANTU
is a 28 foot Wilson craft. The *Xantu* is the Sanctuary's quick response vessel and has proven to be an invaluable management tool in a number of Sanctuary emergencies, including oil spill response. *Xantu* serves as a research and dive platform supporting single day trips.

LAKE RENEGADE SEA WOLF
is a rugged, adaptable, single engine amphibious aircraft designed for extended range with external fuel tanks. The Sanctuary plane conducts aerial monitoring for vessel traffic, marine mammals and kelp canopy coverage. The *Seawolf* can carry one pilot and three observers, cruises at 120 KTS, and has an endurance range of 5 hours/600 NM. Instrumentation includes GPS/Loran, radar altimeter, hardpoints for camera pods and laptop computer with data collection software.



RESEARCH PROGRAM ACHIEVEMENTS TO DATE

OVERVIEW OF CINMS RESEARCH PROGRAM

Project Name	Resource Issues Addressed by Project	Partners
Plumes and Blooms	water quality	UC Santa Barbara, NOAA, NASA, ONR, CSC, COP
BIGHT '98	water quality, ecosystem monitoring	55 agencies and institutions
CODAR	water quality	UC Santa Barbara, NASA, CINP
PISCO	water quality	Packard Foundation, Oregon State, UC Santa Cruz, UC Santa Barbara, Stanford University
SAMSAP	vessel traffic, visitor use, emergency respponse, resource protection	NOAA - AOC, NESDIS
Mapping the Sea Floor	resource protection - site charactrization	US Geological Survey
Marine Reserves Study	resource protection - site characterization	NMFS, US Geological Survey
Breeding Colony & Roost Surveys	resource protection - site characterization	Humbolt State University, USGS, US Navy, US Fish and Wildlife Service, American Trader Trustee Council, CDFG, CINP, MMS
Seabird Studies	resource protection - ecosystem monitoring	Humbolt State University, USGS, US Navy, US Fish and Wildlife Service, American Trader Trustee Council, CDFG, CINP, MMS
Kelp Forest Monitoring - CINP	resource protection - ecosystem monitoring	CINP, CDFG
Rocky Intertidal Monitoring	resource protection - ecosystem monitoring	CINP, UCSB, MMS
Fisherman's Monitoring Program	resource protection - ecosystem monitoring	NMFS
Remote Sensing	resource protection tool	NMP, NESDIS
Data Management	resource protection tool, emergency response, water quality, vessel traffic, visitor use	in-house
Research Interpretation	resource protection tool	CINMS Education Dept., Sanctuary Advisory Council